Using IDC for Estimating Recharge Rates of a MODFLOW Model

Prepared for

IWFM Users Group Meeting

Prepared by

Reza Namvar and Jon Traum

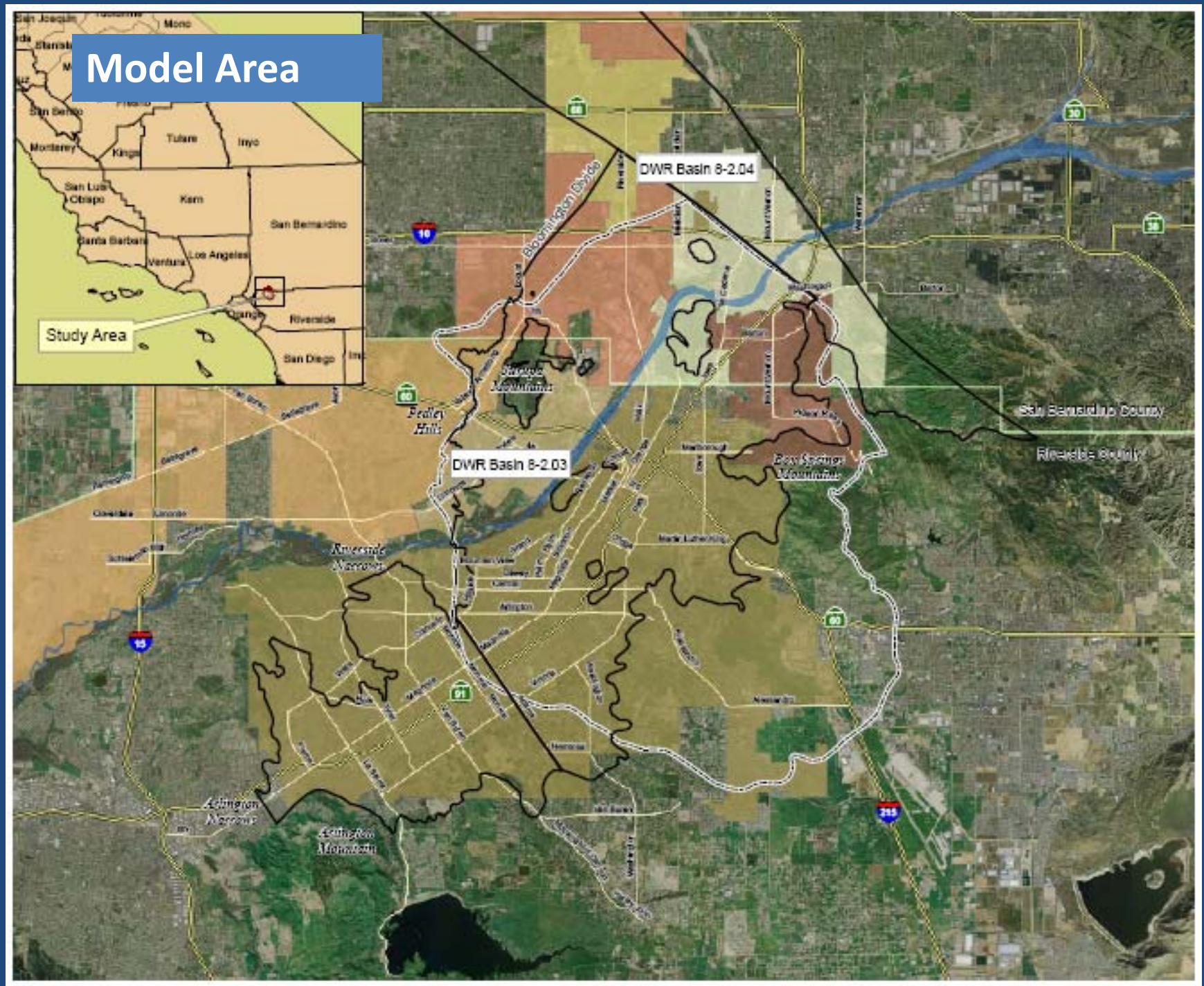
WRIME, Inc.

December 9, 2010

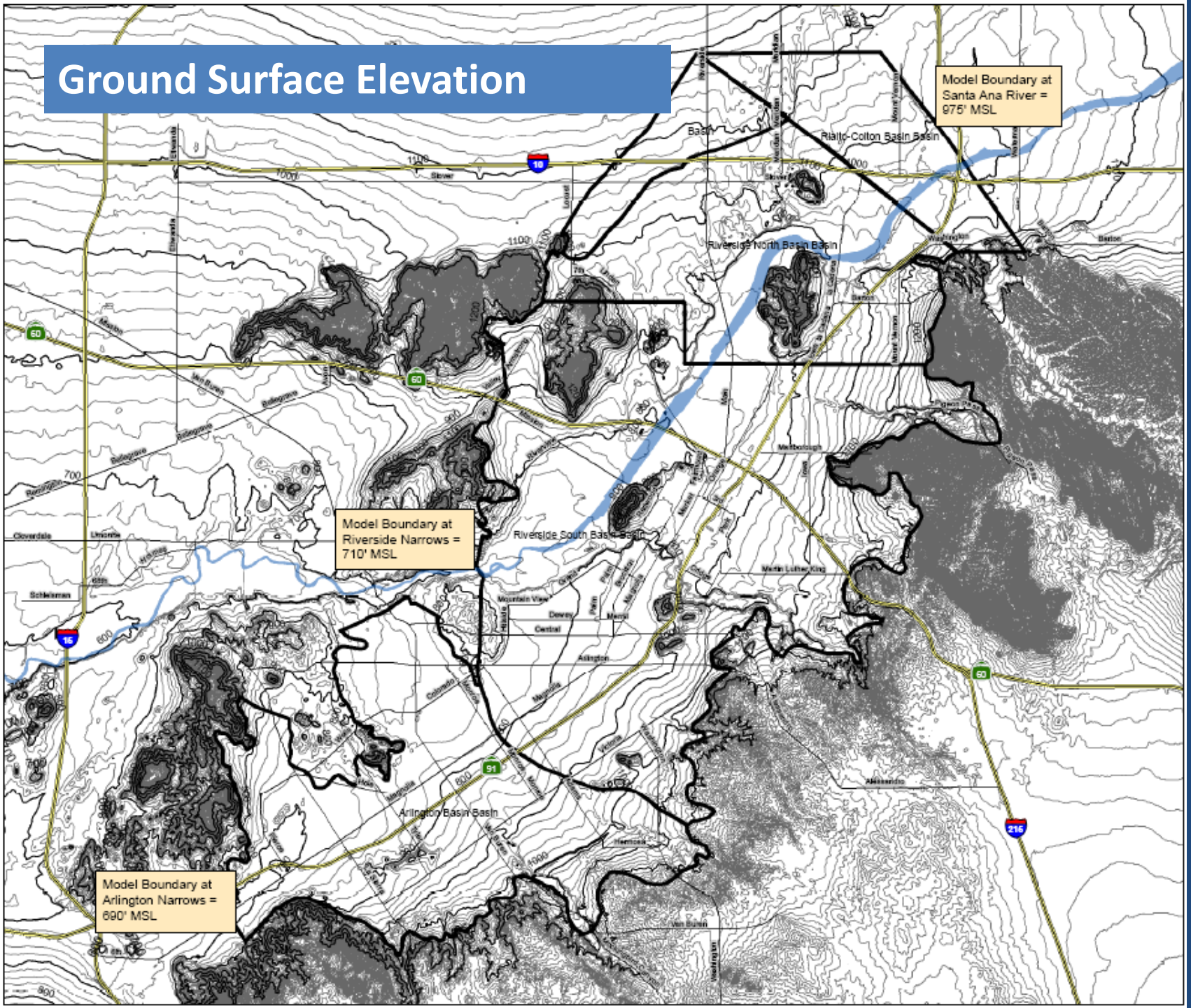
WRIME

Presentation Outline

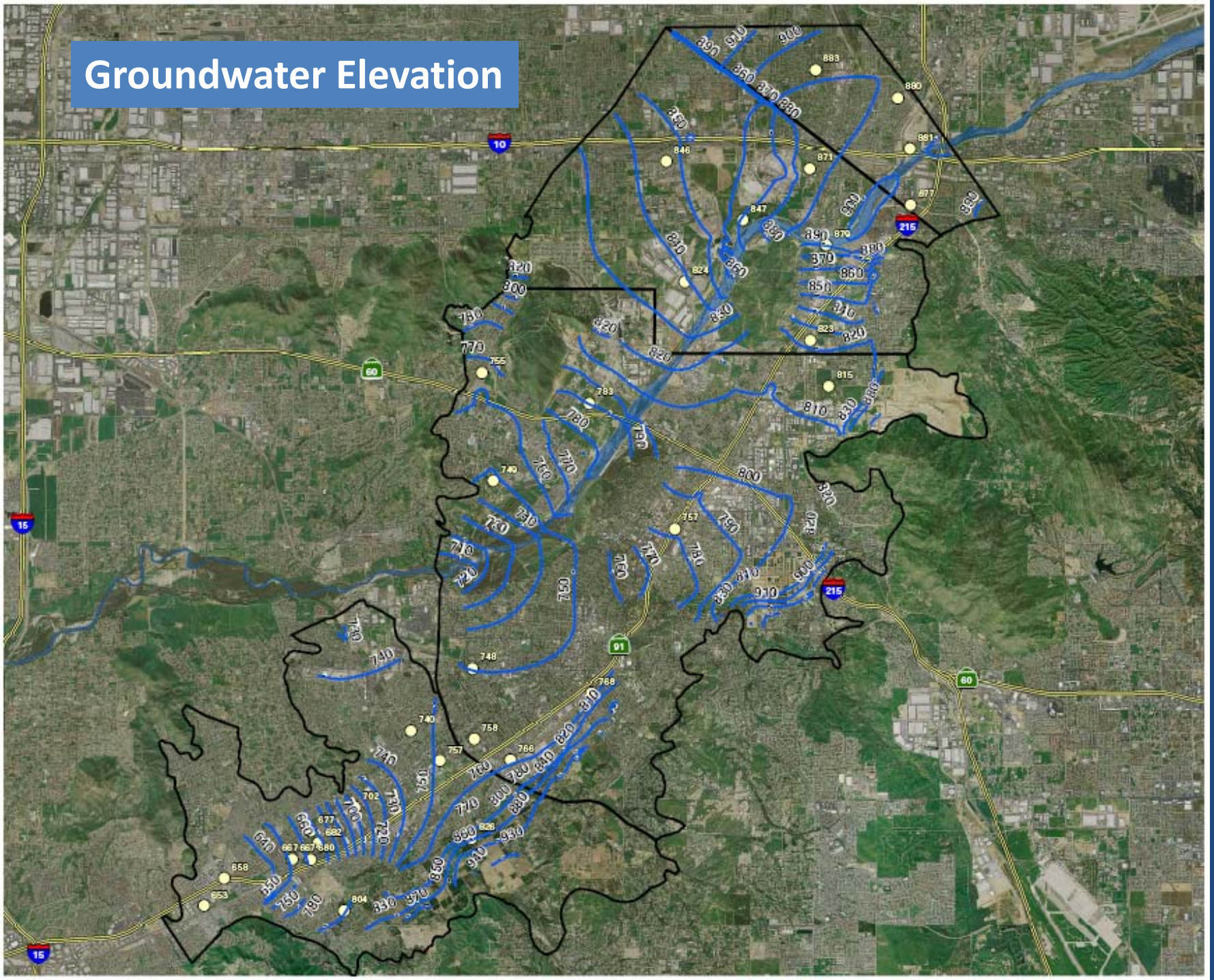
- Model Area
- MODFLOW Model
- IWFM Demand Calculator (IDC) Model
- Consistency of IDC and MODFLOW Recharge Rates
- Model Results

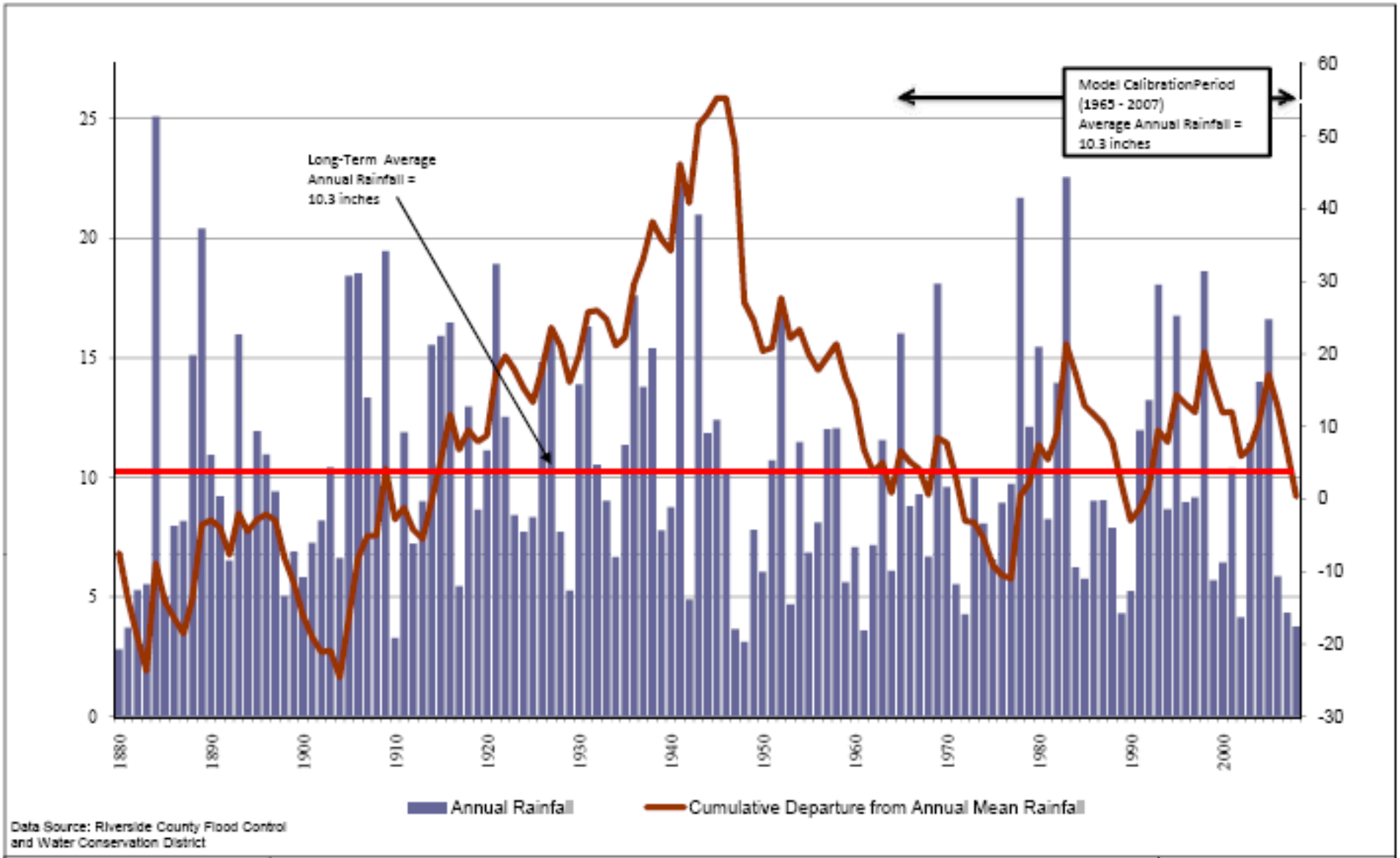

Model Area
Study Area
DWR Basin 8-2.04
DWR Basin 8-2.03
Bloomington Divide
Box Spring Mountains
San Bernardino County
Riverside County
Riverside Narrows
Arlington Narrows
Arlington Mountain
Pedley Hills

Ground Surface Elevation



Groundwater Elevation

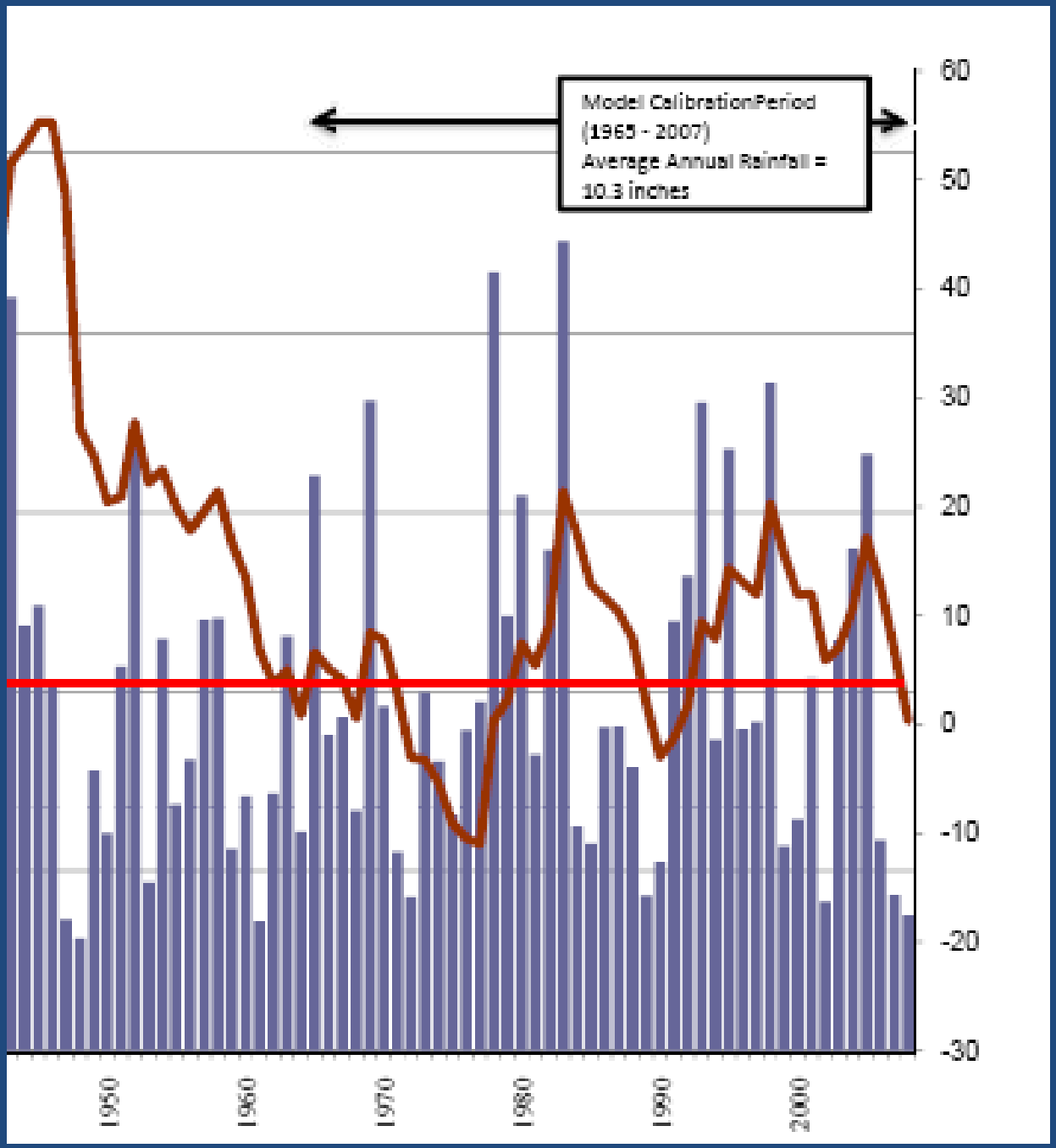


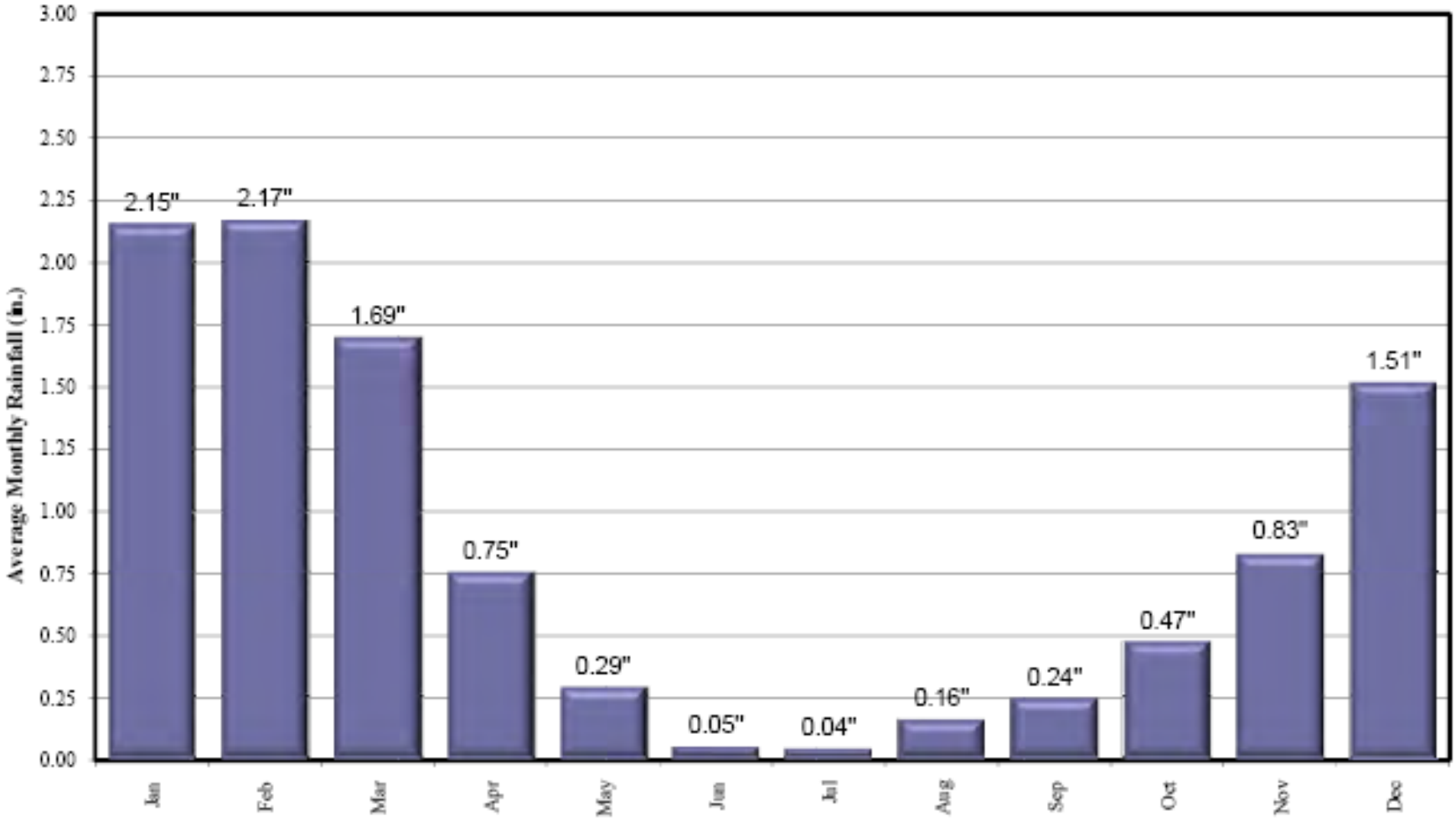


Data Source: Riverside County Flood Control and Water Conservation District

Annual Rainfall At Riverside Station 179

Figure 9
April 2010


Model CalibrationPeriod
(1965 - 2007)
Average Annual Rainfall =
10.3 inches
60
50
40
30
20
10
0
-10
-20
-30
1950
1960
1970
1980
1990
2000



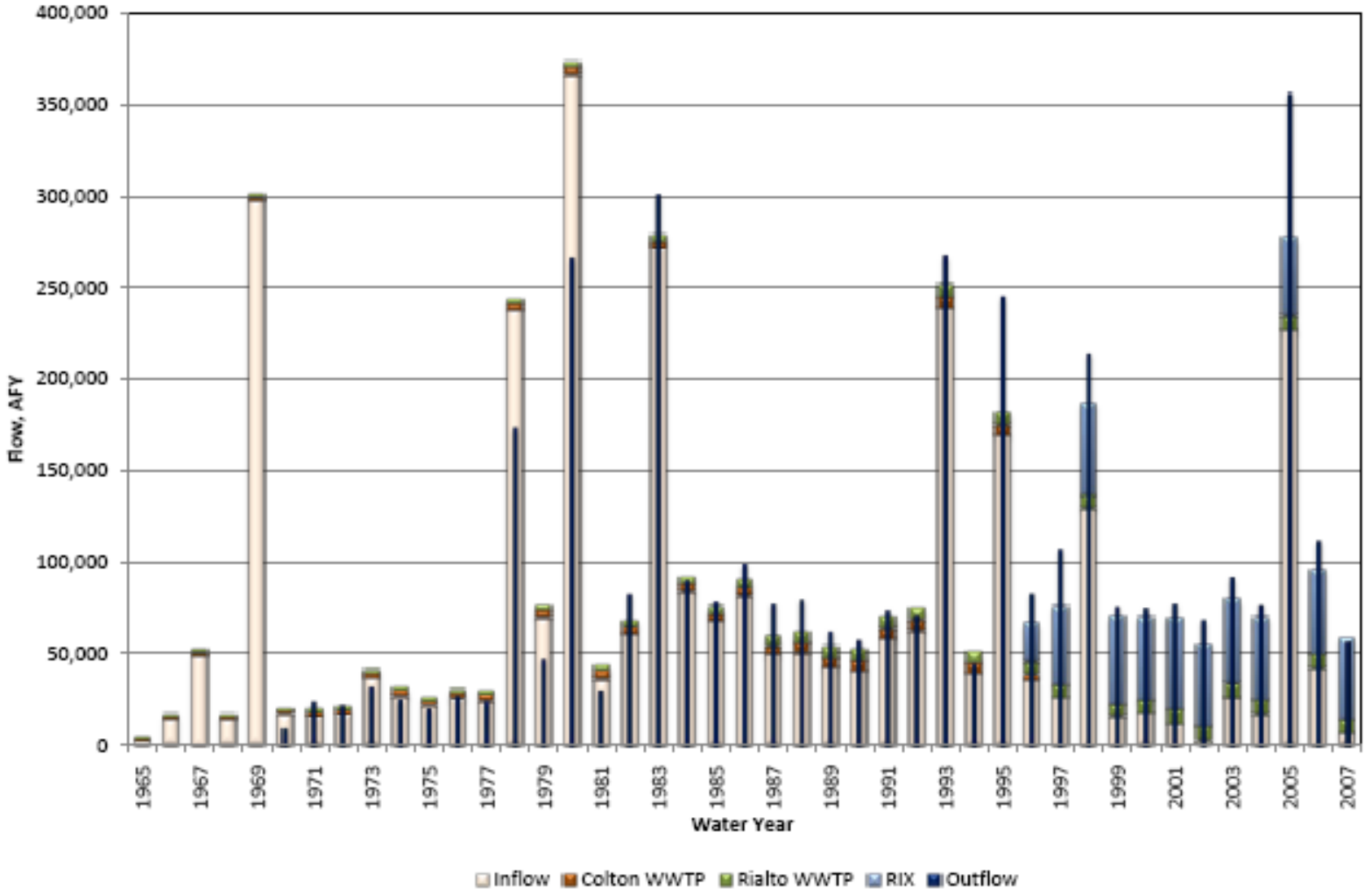
Data Source: Riverside County Flood Control and Water Conservation District

Average Monthly Rainfall at Riverside Station 179

(1880 to 2008 Hydrological Conditions)

Figure 11

April 2010

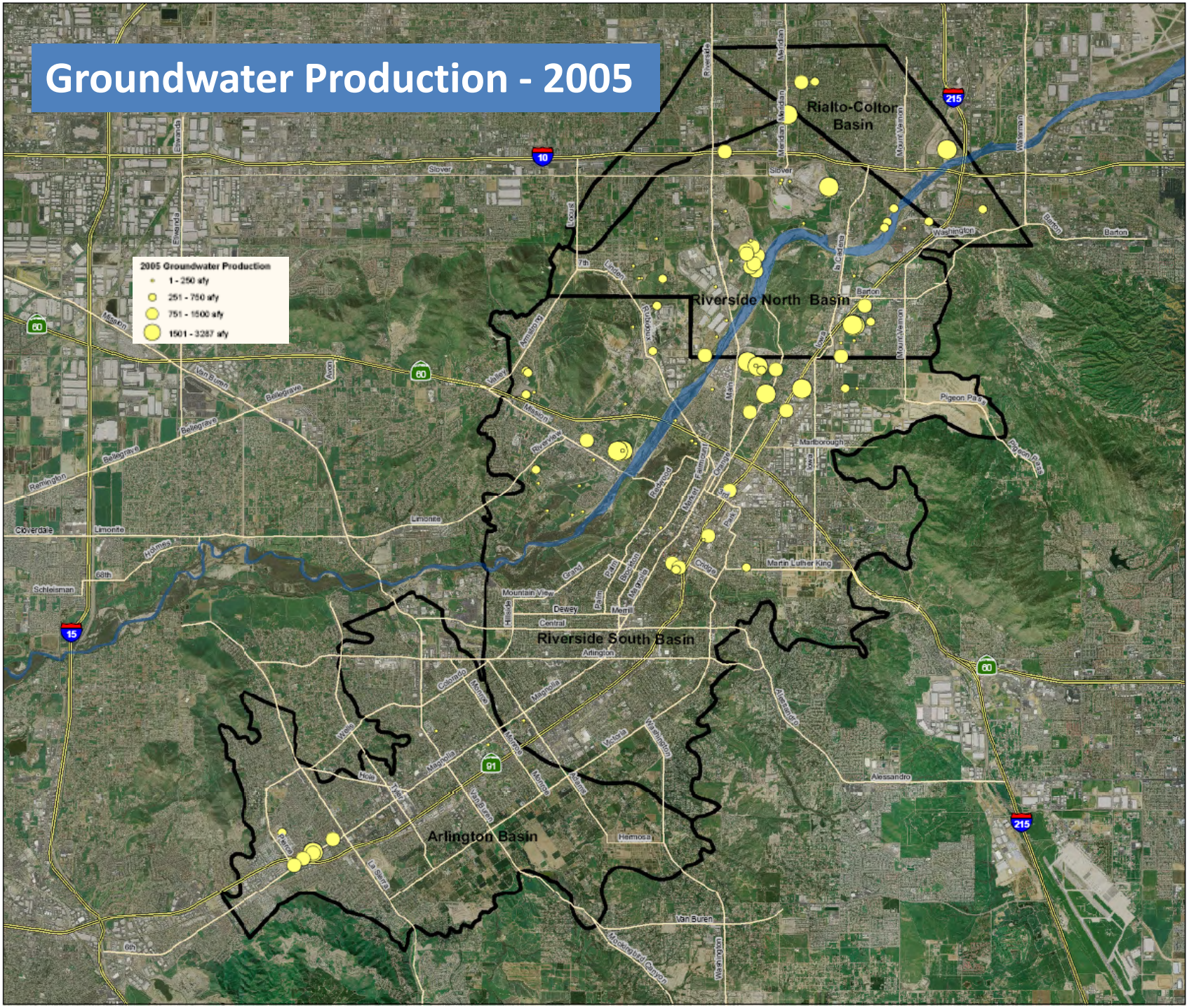


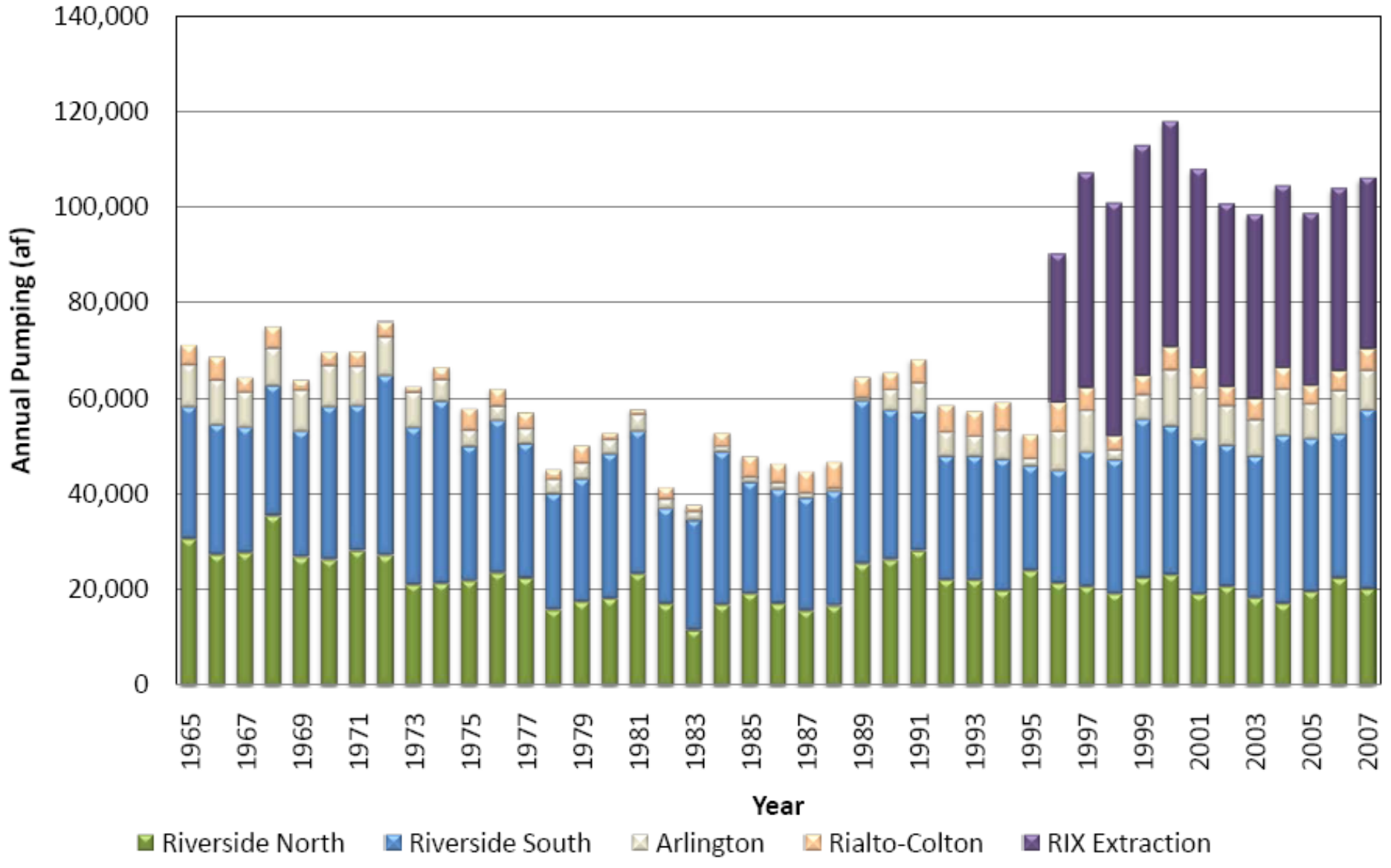
Santa Ana River Annual Inflows and Outflow, (AFY)

(Inflow is the sum of streamflows measured at USGS gages at Lytle Cr, Warm Cr, and E St. Outflow is measured at MWD Crossing.)

Figure 12
April 2010

Groundwater Production - 2005





CITY OF RIVERSIDE

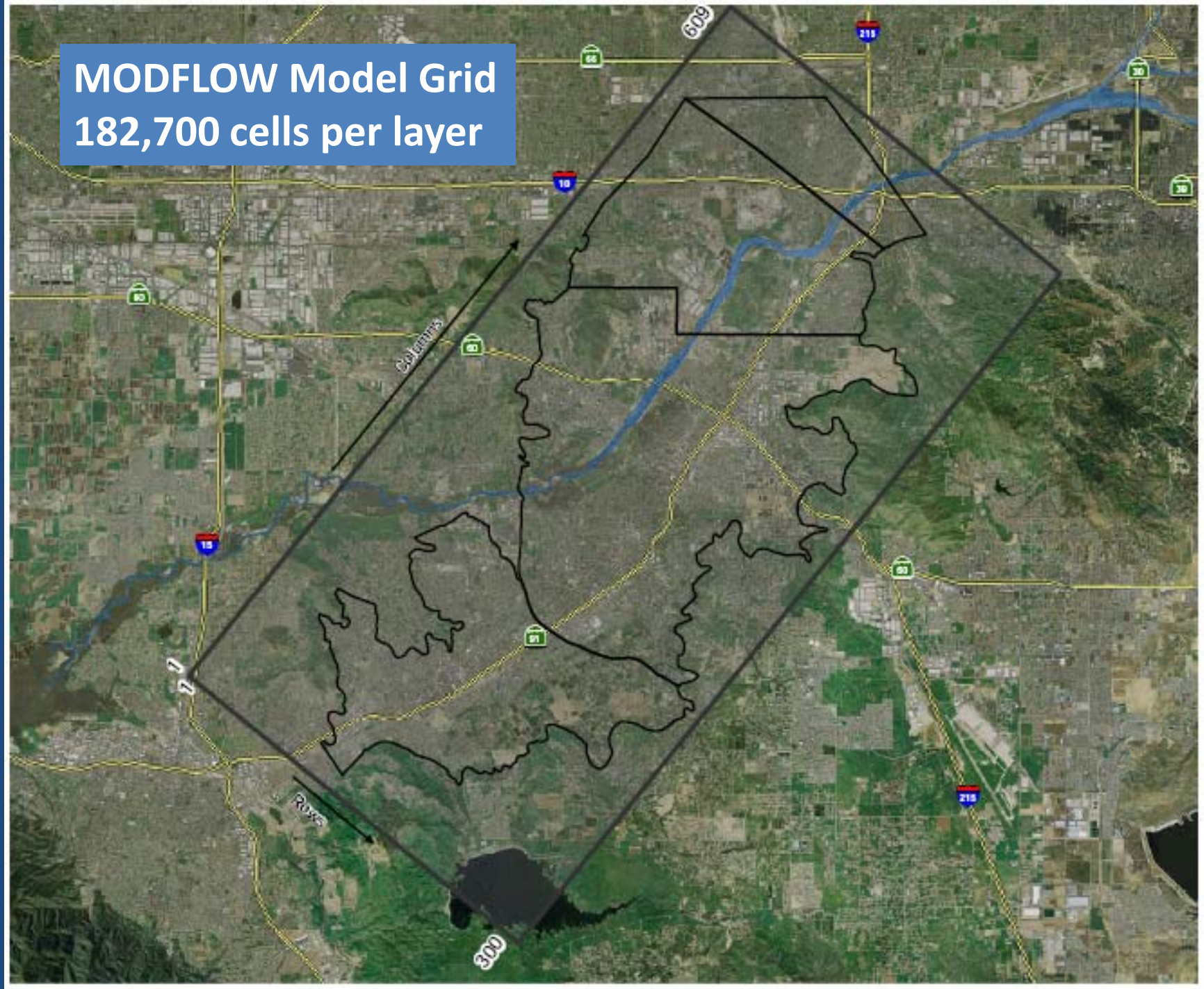
WESTERN MUNICIPAL WATER DISTRICT

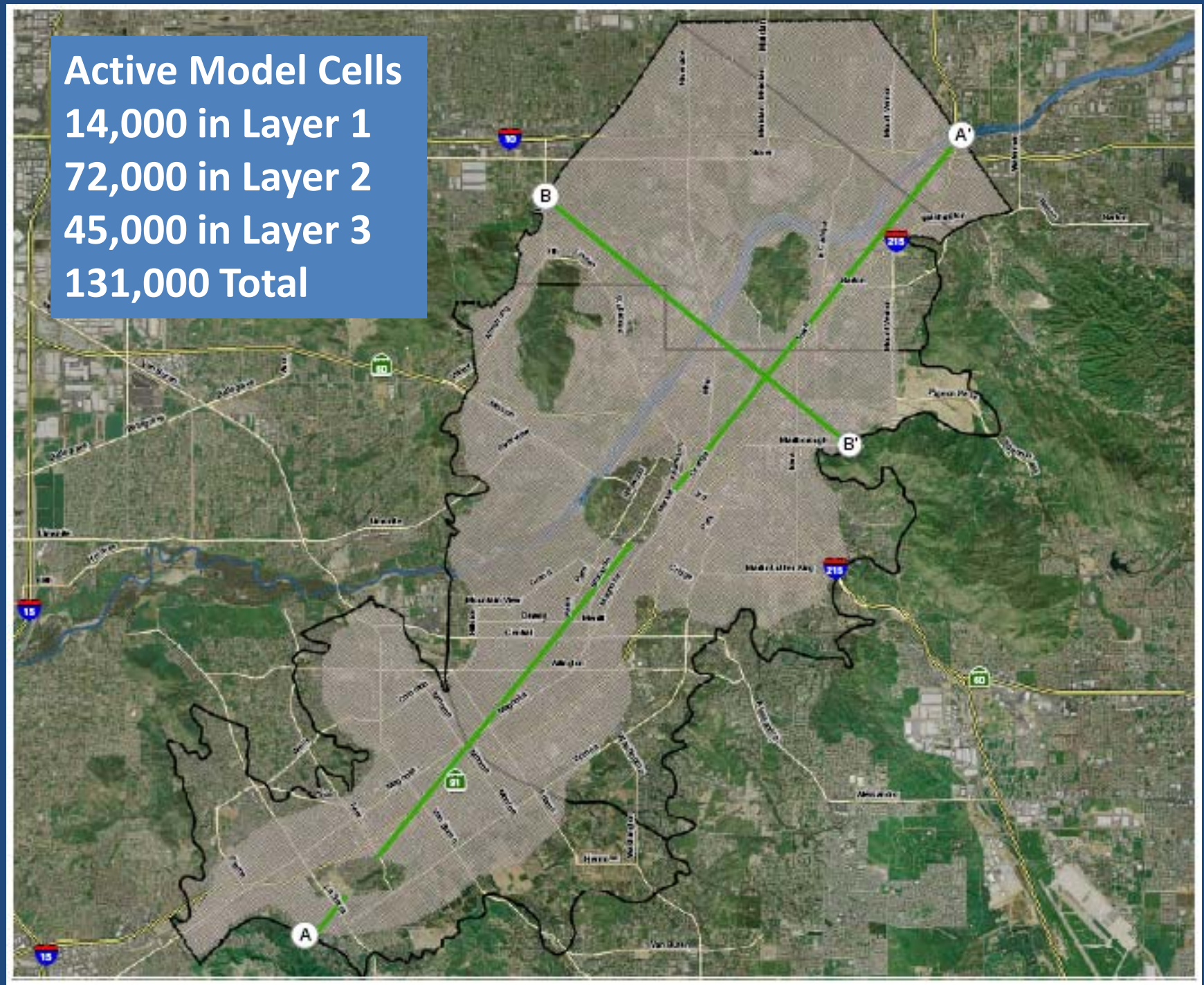
Groundwater Production from Wells in Model Area

Figure 24

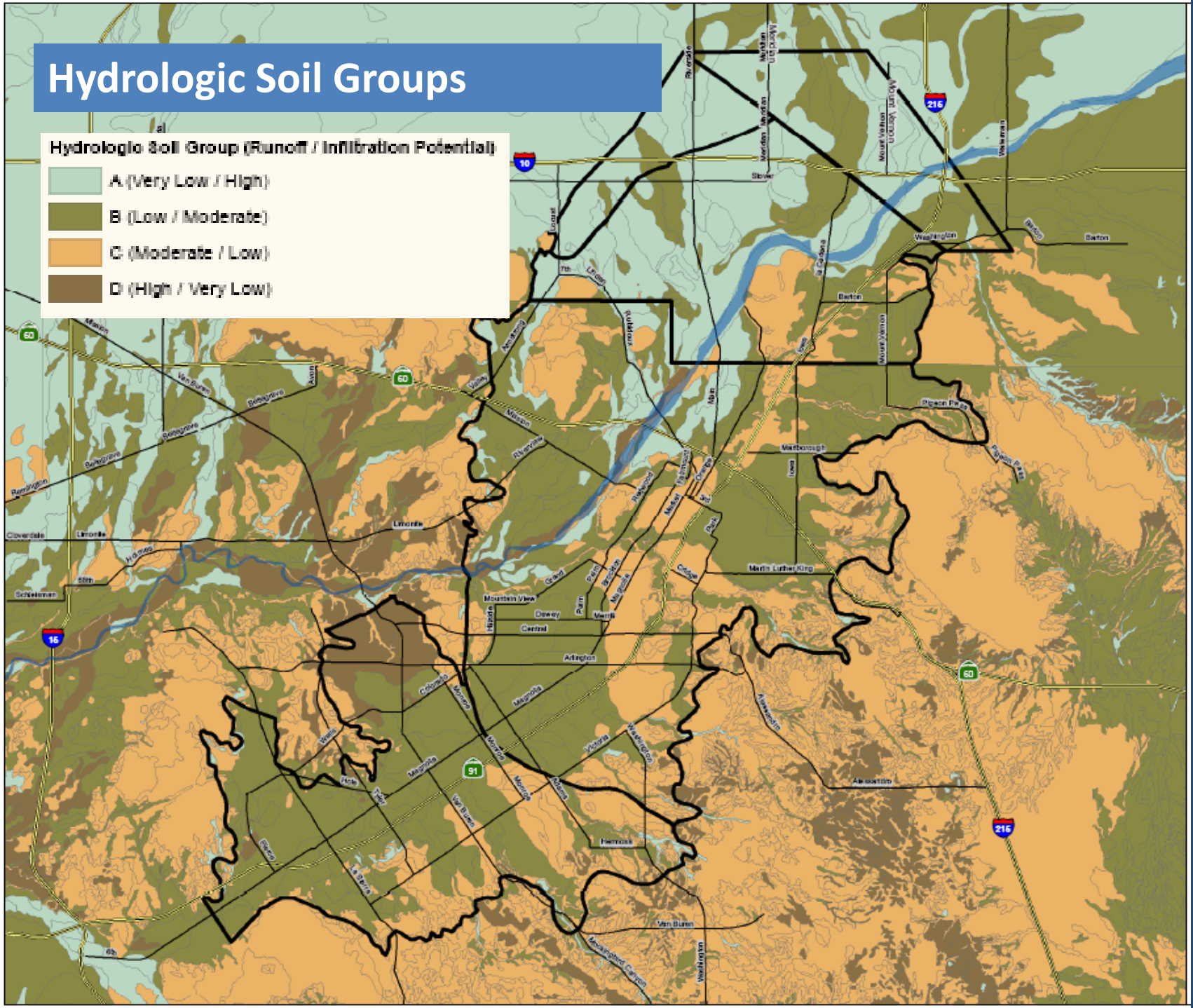
April 2010

ωRIME

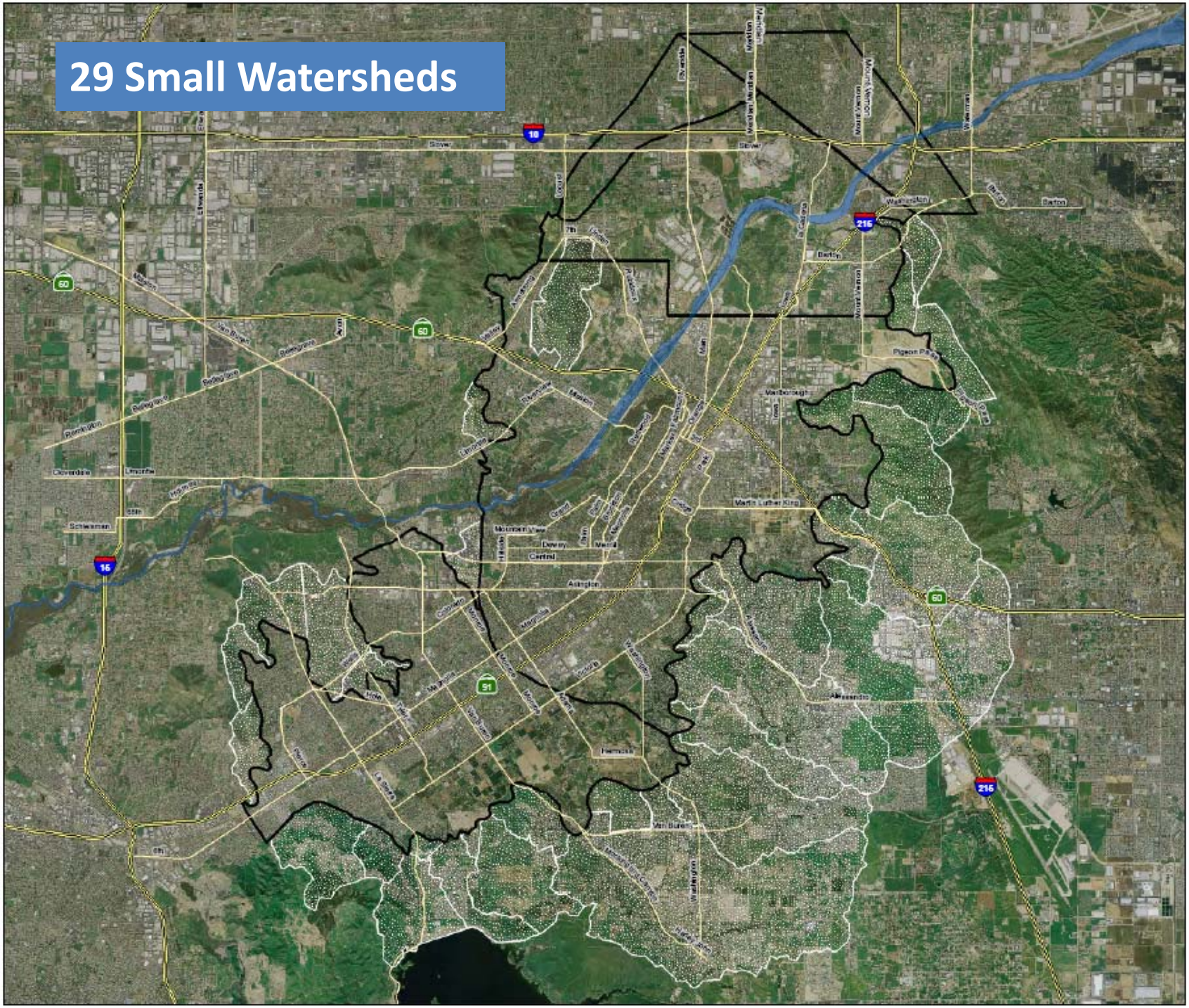

MODFLOW Model Grid
182,700 cells per layer
609
300
Columns
Rows

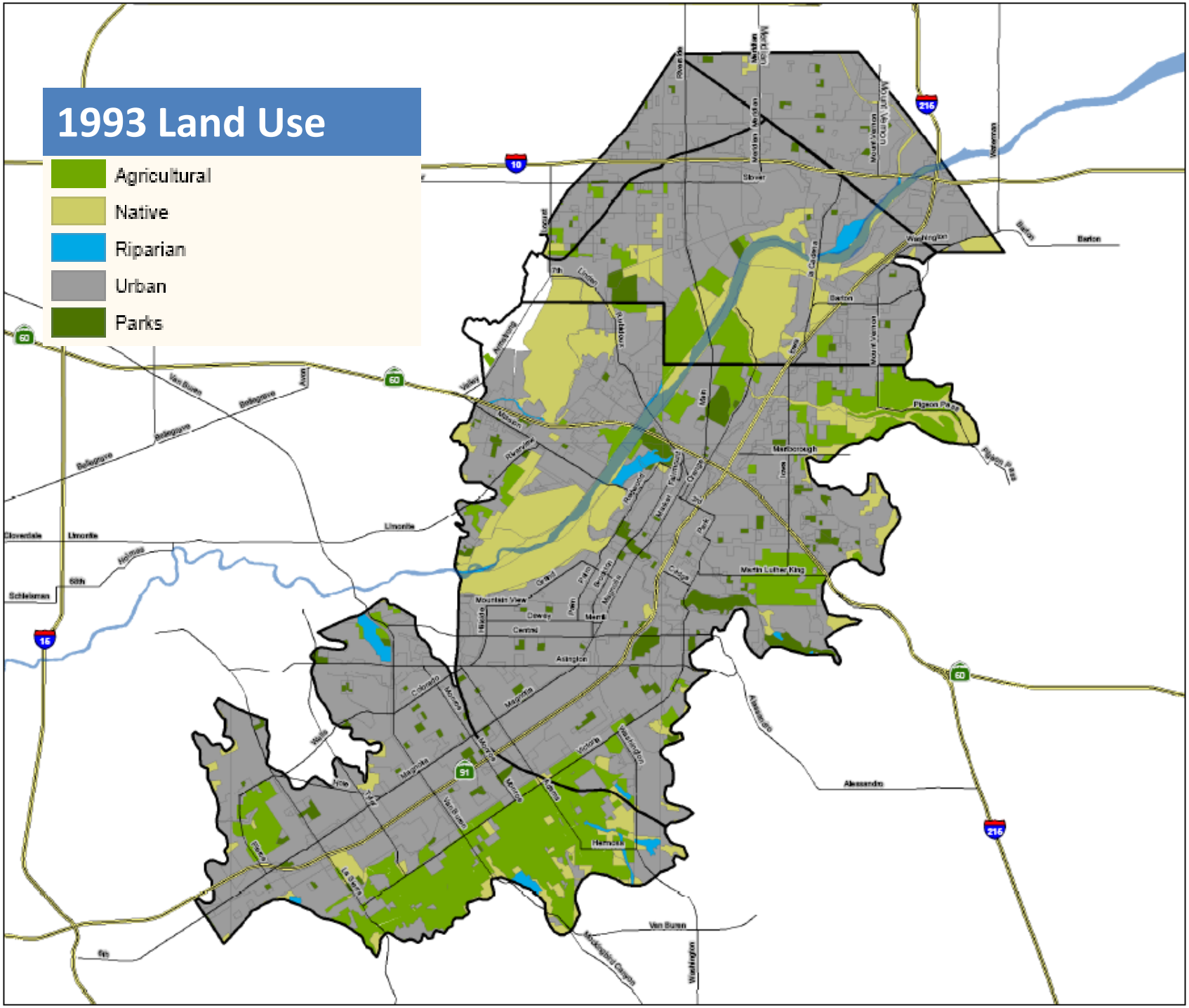

Active Model Cells
14,000 in Layer 1
72,000 in Layer 2
45,000 in Layer 3
131,000 Total
A
A'
B
B'

Hydrologic Soil Groups

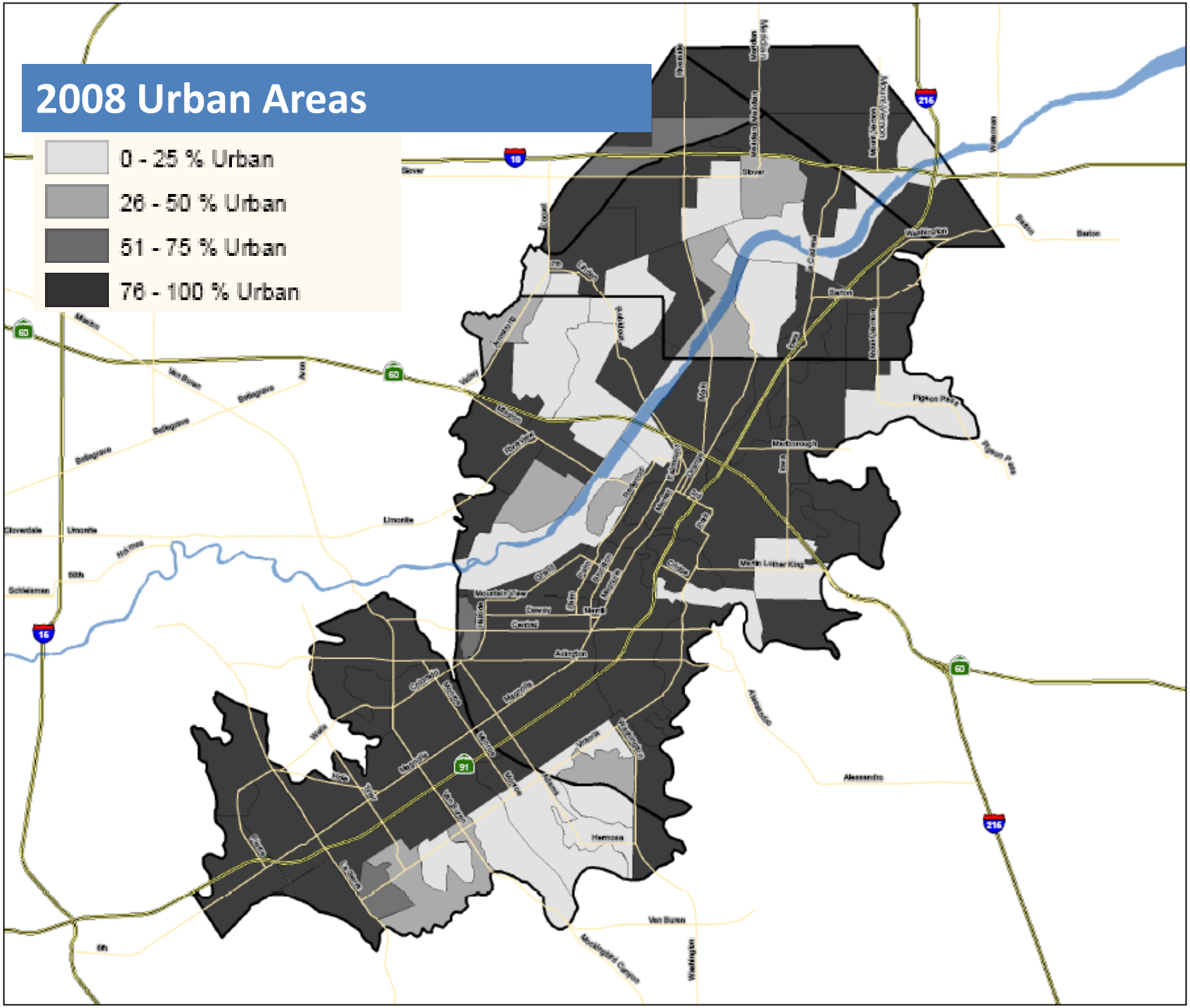


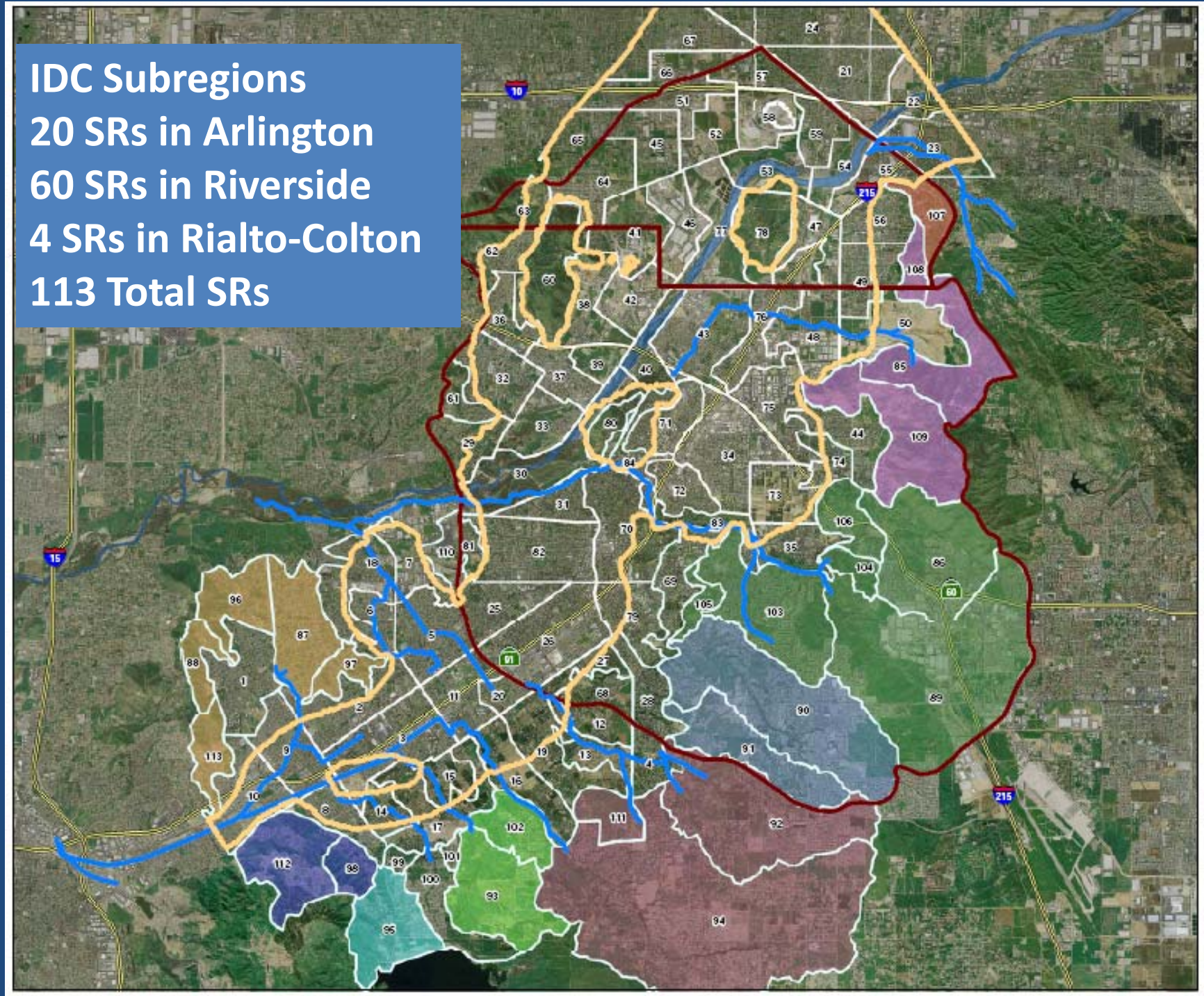
29 Small Watersheds




1993 Land Use
Agricultural
Native
Riparian
Urban
Parks

2008 Urban Areas




IDC Subregions
20 SRs in Arlington
60 SRs in Riverside
4 SRs in Rialto-Colton
113 Total SRs

Subregion	Basin	Soil Class	Land use (acres)				Total Area (acres)
			AG	URB	NV	PARK	
Arlington			3,641	10,375	269	564	14,849
Riverside			1,525	27,516	12,083	1,821	42,946
Rialto-Colton			0	3,848	525	129	4,502
Total Model Area			**5,167**	**41,739**	**12,877**	**2,515**	**62,297**
Small Watersheds			2,594	19,663	18,421	644	41,323

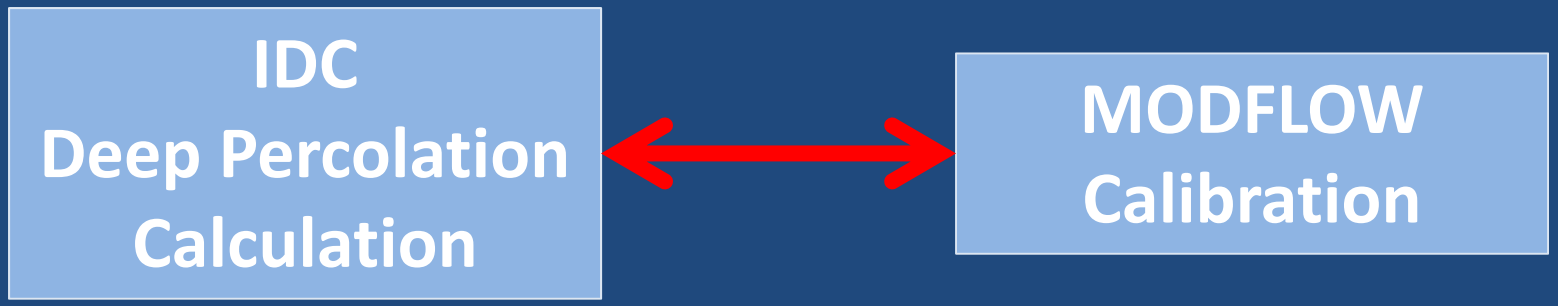
Calculation of Deep Percolation/Recharge Rates using IDC

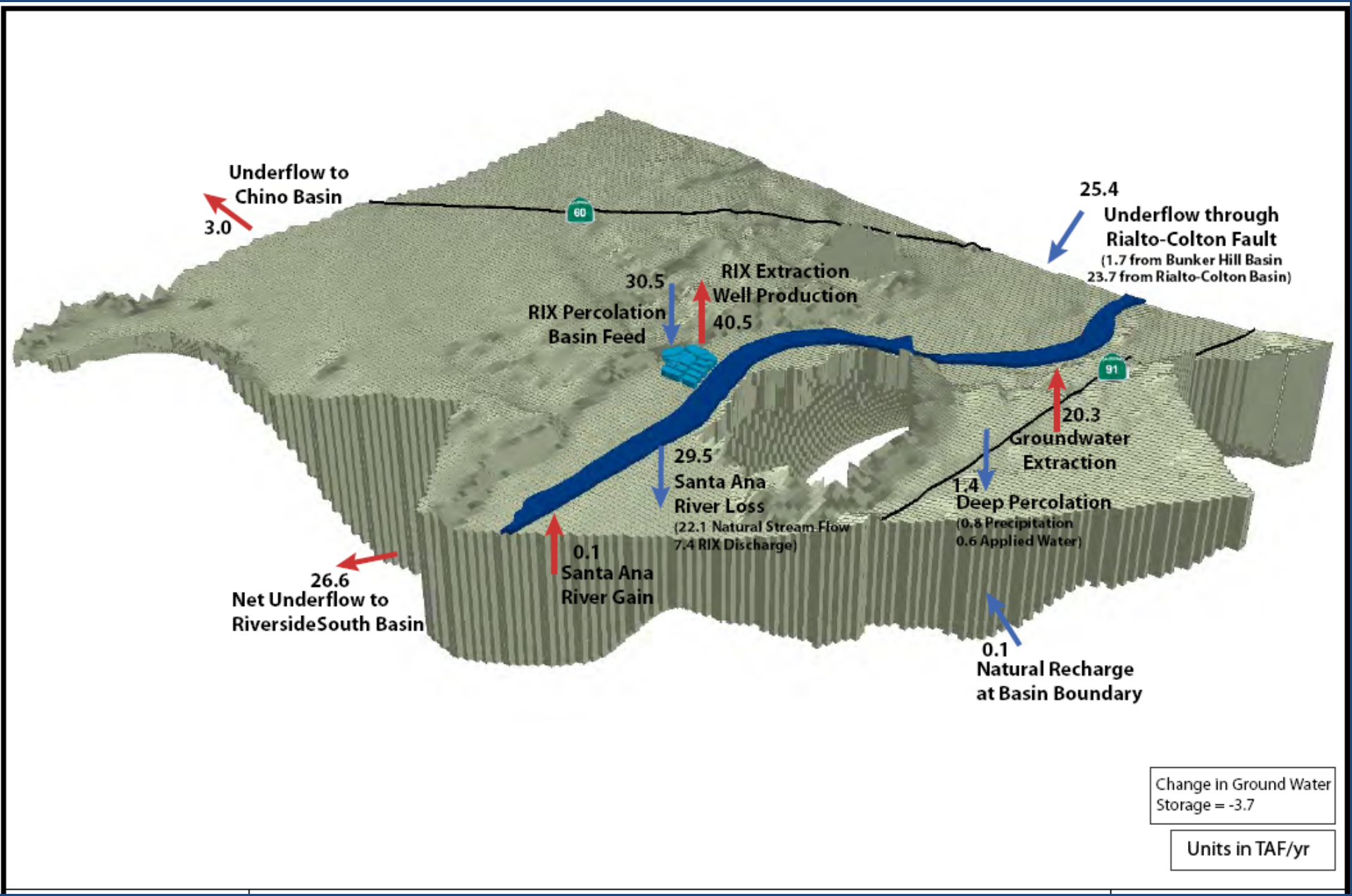
- IDC calculates deep percolation / groundwater recharge from:
  - Rainfall
  - Applied water
- IDC calculation are performed for subregions (areas with similar land use and soil type)
  - 84 subregions
  - 29 small watersheds
- Using GIS, IDC recharge rates are applied to MODFLOW model cells

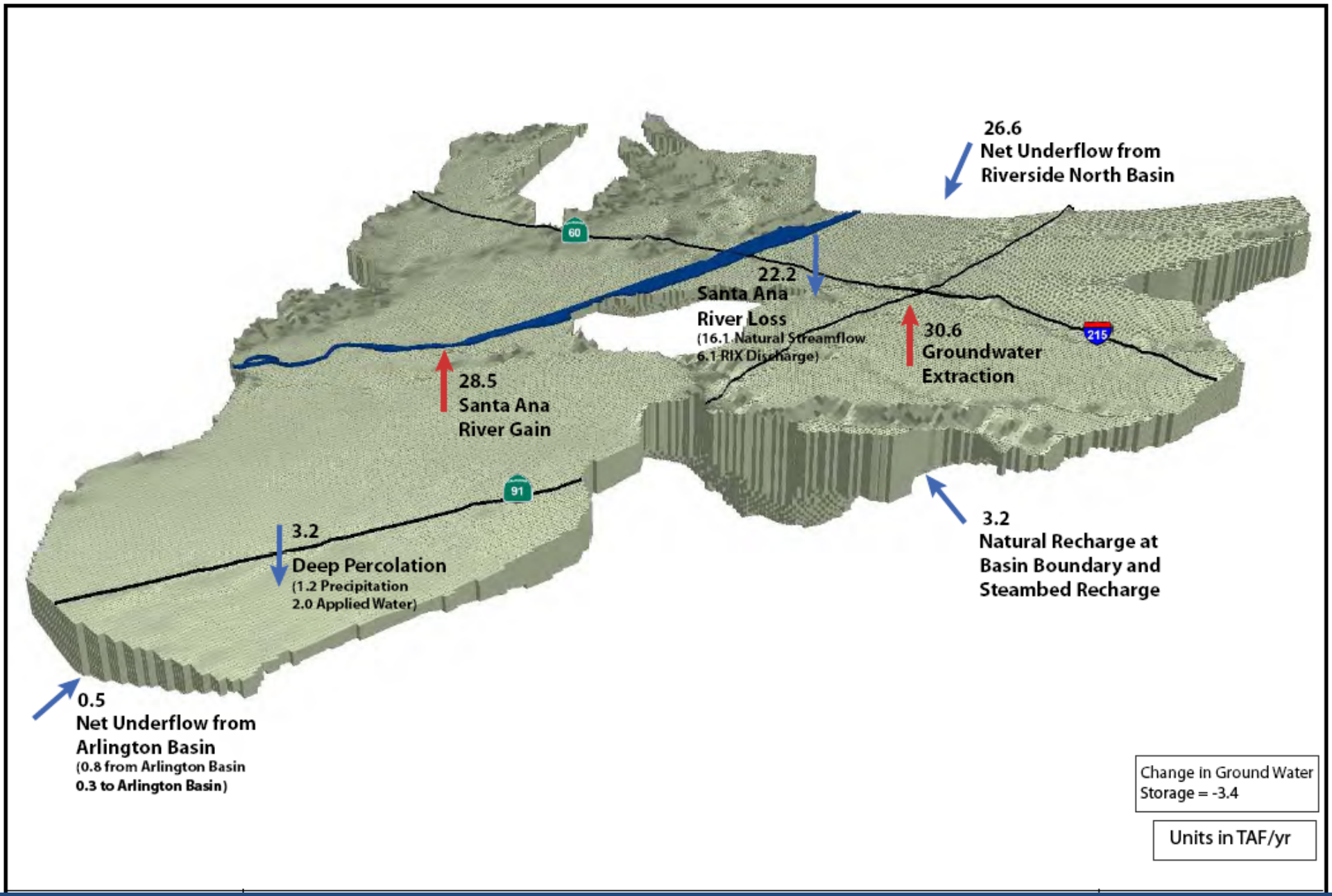
IDC Model Summary

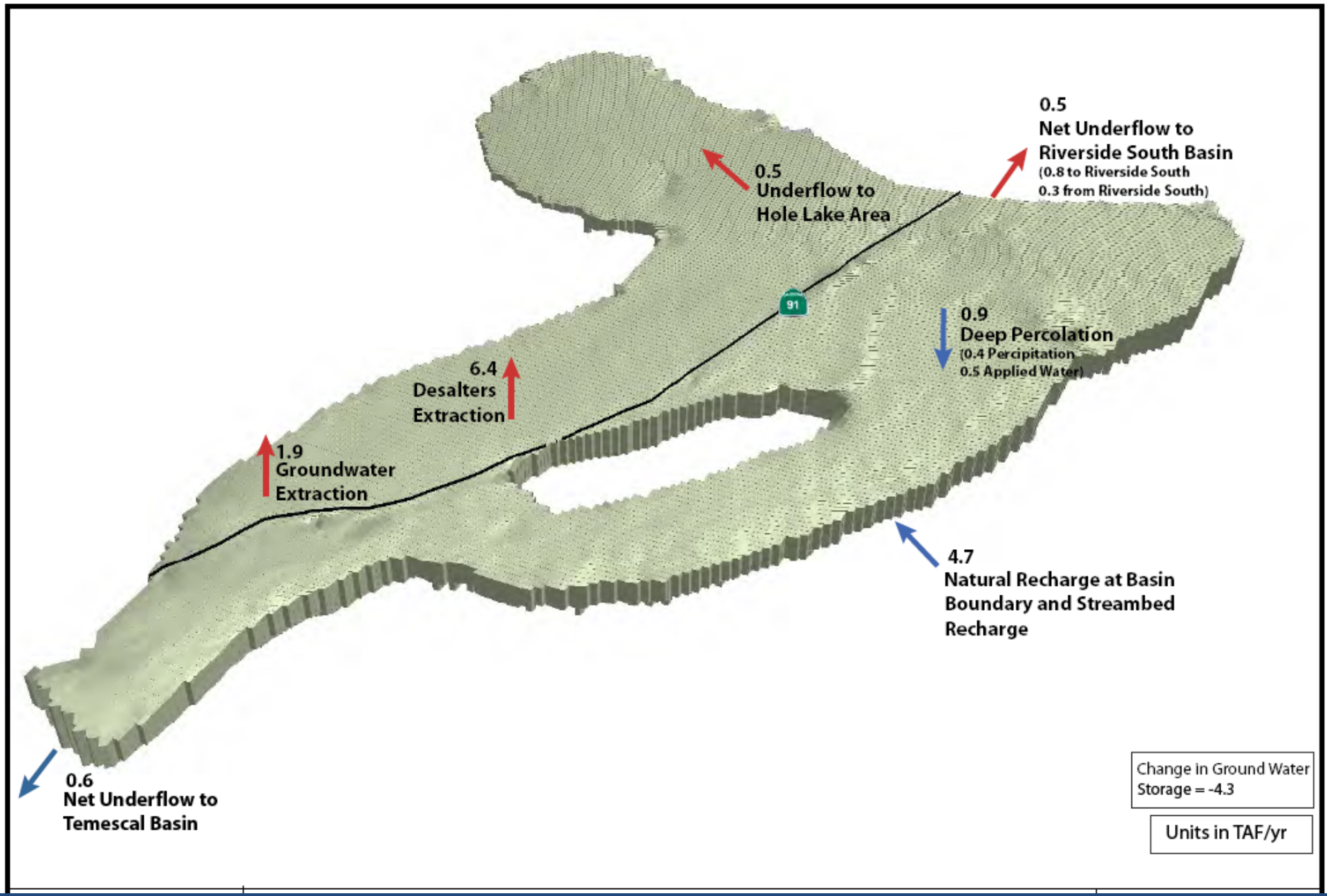
- Simulation Period: 1965 – 2007
- Time Step: 1 day
- Subregions: 113
- Crop Types: 2 (Parks and Citrus)
- Infiltration of Precipitation is computed (KINFILT = 0)
- No Reuse of Surface Runoff
- Daily Rainfall Data

Consistency of IDC and MODFLOW Recharge Rates




Underflow to
Chino Basin
3.0
60
25.4
Underflow through
Rialto-Colton Fault
(1.7 from Bunker Hill Basin
23.7 from Rialto-Colton Basin)
30.5
RIX Percolation
Basin Feed
RIX Extraction
Well Production
40.5
91
20.3
Groundwater
Extraction
29.5
Santa Ana
River Loss
(22.1 Natural Stream Flow
7.4 RIX Discharge)
1.4
Deep Percolation
(0.8 Precipitation
0.6 Applied Water)
0.1
Santa Ana
River Gain
26.6
Net Underflow to
RiversideSouth Basin
0.1
Natural Recharge
at Basin Boundary
Change in Ground Water
Storage = -3.7
Units in TAF/yr


26.6
Net Underflow from
Riverside North Basin
22.2
Santa Ana
River Loss
(16.1 Natural Streamflow
6.1 RIX Discharge)
30.6
Groundwater
Extraction
28.5
Santa Ana
River Gain
3.2
Deep Percolation
(1.2 Precipitation
2.0 Applied Water)
3.2
Natural Recharge at
Basin Boundary and
Steambed Recharge
0.5
Net Underflow from
Arlington Basin
(0.8 from Arlington Basin
0.3 to Arlington Basin)
60
91
215
Change in Ground Water
Storage = -3.4
Units in TAF/yr


0.5
Net Underflow to
Riverside South Basin
(0.8 to Riverside South
0.3 from Riverside South)
0.5
Underflow to
Hole Lake Area
91
0.9
Deep Percolation
(0.4 Percipitation
0.5 Applied Water)
6.4
Desalters
Extraction
1.9
Groundwater
Extraction
4.7
Natural Recharge at Basin
Boundary and Streambed
Recharge
0.6
Net Underflow to
Temescal Basin
Change in Ground Water
Storage = -4.3
Units in TAF/yr

THE END

MODFLOW Model

- Simulated Basins
  - Arlington, Riverside, southern parts of Rialto-Colton Basins in Riverside and San Bernardino Counties
- Model Grid
  - 95 square miles
  - Uniform cell size (50 m x 50 m)